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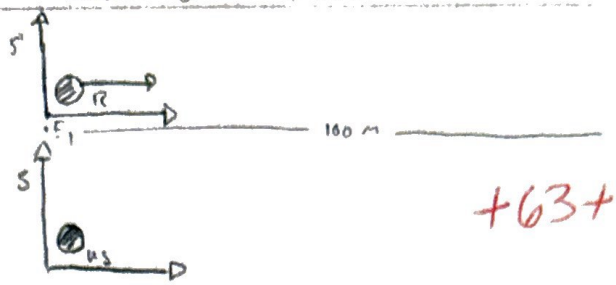
Dr Middleton
PHYS 230

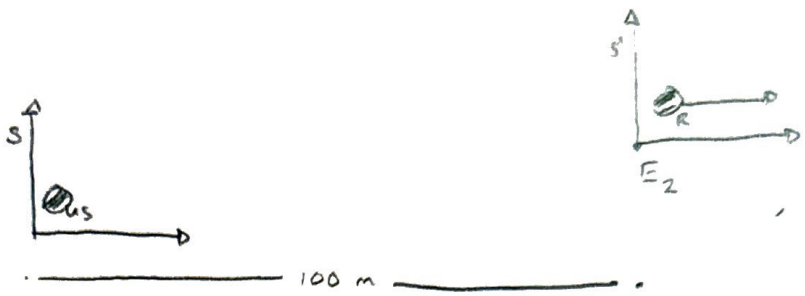
Exam 2 Problem 1

E_1



+63 + 37/5 = 70.4%

E_2



a.) when the racer (Ed) passes marker 1, when Ed passes marker 2

b.) $D = 100\,m$

$\Delta t = 4.0\times10^{-7}\,s$

$V = \frac{D}{\Delta t} = \frac{100\,m}{4.0\times10^{-7}\,s} = 2.5\times10^{8}\,m/s$

$C = 3.0\times10^{8}\,m/s$ $\quad \frac{V}{C} = \frac{2.5\times10^{8}\,m/s}{3.0\times10^{8}\,m/s} = \frac{5}{6}$

$V = \left(\frac{5}{6}\right)C$

c.) Since $\Delta x' = 0$

$d = D\cdot\sqrt{1-(V/c)^2} = 100m\sqrt{1-(5/6)^2} = 100m\left(\frac{\sqrt{11}}{\sqrt{36}}\right) = 100m\left(\frac{\sqrt{11}}{6}\right) = 55\,m$

$D = 100m$

$d = 55\,m$

d.) Since $\Delta x' = 0$ $\quad t = \gamma(t') \therefore t' = t\gamma^{-1}$

$t = 4.0\times10^{-7}\,s$

$\gamma' = \frac{\sqrt{11}}{6}$

$\gamma = \frac{6\sqrt{11}}{11}$

$\Delta t' = \frac{\sqrt{11}}{6}\left(4.0\times10^{-7}\,s\right) = 2.2\times10^{-7}\,s$

$\Delta t' = 2.2\times10^{-7}\,s$

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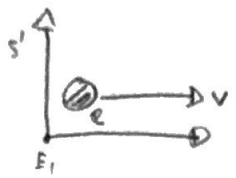
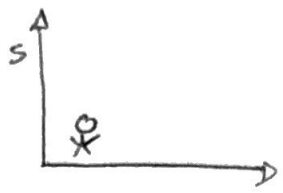
Exam 2 Problem 2

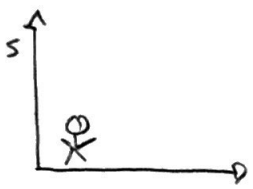
E_1

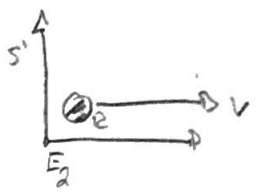


+19



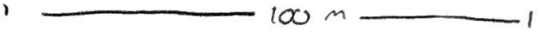
E_2





$\Delta x = 100\ m$

$\Delta t' = 4.0 \times 10^{-7} s$



$\Delta x' = 0$

∞ observers in S' $\therefore \Delta t' = 0 X$. $x = \gamma x'$ $\therefore x' = \gamma^{-1}(x)$

$X = \gamma(+vT')$

$\Delta x = \dfrac{v(\Delta t')}{\sqrt{1-(v/c)^2}}$

$\Delta x\left(\sqrt{1-(v/c)^2}\right) = v(\Delta t')$ ✓

$(\Delta x)^2(1-(v/c)^2) = v^2(\Delta t')^2$ ✓

$\Delta x^2 - \Delta x^2(v/c)^2 = v^2(\Delta t')^2$ ✓

$\Delta x^2 = v^2(\Delta t')^2 + \Delta x^2(v/c)^2$ ✓

$\dfrac{\Delta x^2}{c^2} = \dfrac{v^2}{c^2}\Delta t'^2 + \Delta x^2\dfrac{v^2}{c^4}$ ✓

$\dfrac{\Delta x^2}{c^2} = \dfrac{v^2}{c^2}\left(\Delta t'^2 + \dfrac{\Delta x^2}{c^2}\right)$ ✓

$\dfrac{v^2}{c^2} = \dfrac{\frac{\Delta x^2}{c^2}}{\Delta t'^2 + \frac{\Delta x^2}{c^2}}$ ✓

$\dfrac{v}{c} = \sqrt{\dfrac{\Delta x^2}{c^2\Delta t'^2 + \Delta x^2}}$ ✓

$\dfrac{v}{c} = \sqrt{\dfrac{(100\ m)^2}{(3.00\times10^8)^2 m/s (4.0\times10^{-7}) s + (100m)^2}}$

$\dfrac{v}{c} = 0.64c$ ✓

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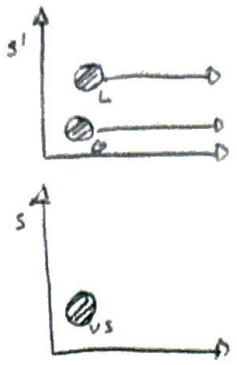
Exam 2 Problem 3



$$v_x = \frac{v_x' + V}{1 + V v_x'/c^2}$$

$$v_x' = \frac{v_x - V}{1 - V \cdot v_x/c^2}$$

$v_L = (4/5)c$ $v_G = (3/5)c$

+12

a) RF of Gazelle...

$V = (3/5)c$

$v_x = (4/5)c$

$$v_x' = \frac{(4/5)c - (3/5)c}{1 - \frac{(4/5)c(3/5)c}{c^2}} = \frac{(1/5)c}{13/25} = \frac{5/25}{13/25} = \frac{5}{13}$$

$v_x' = (5/13)c$ Rightward ✓

b) RF of Lion....

$V = (4/5)c$

$v_x = (3/5)c$

$$v_x' = \frac{(3/5)c - (4/5)c}{1 - \frac{(4/5)c(3/5)c}{c^2}} = \frac{-(1/5)c}{(13/25)} = \frac{-(5/25)c}{(13/25)} = (-5/13)c$$

$v_x' = (-5/13)c$ Leftward ✓

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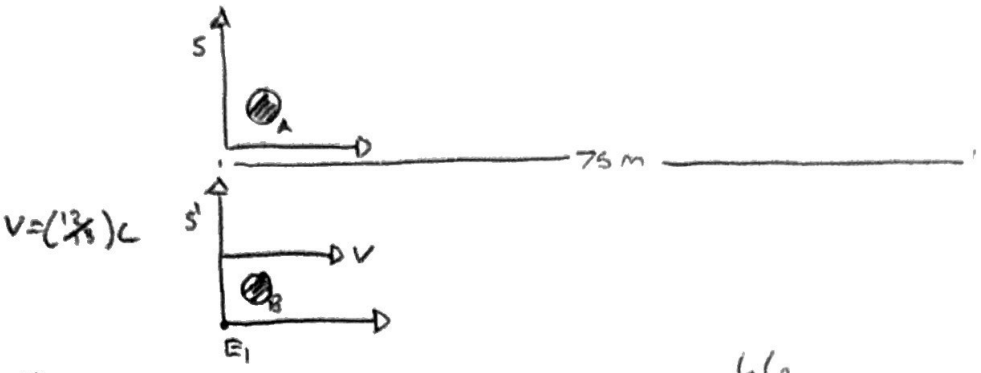
Exam 2 Problem 4

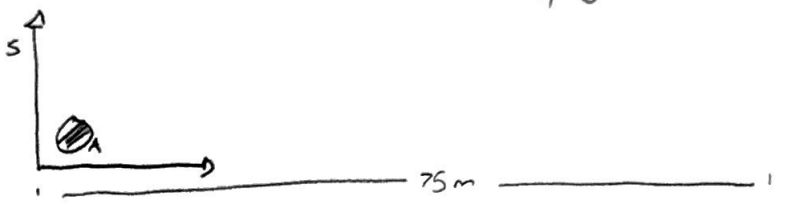
E_1



$V=(\frac{12}{13})c$

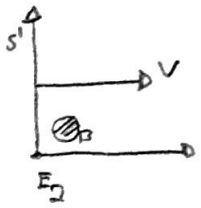
+6

E_2



$x_1=0 \quad t_1=0 \quad x_2=75\,m \quad t_2=2.0\times10^{-6}s$

$x_1'=0 \quad t_1'=0 \quad x_2'= \quad t_2'=4.6\times10^{-6}s$



$V=(\frac{12}{13})c \quad \gamma=(\frac{13}{5})$

$t'=\gamma(t-Vx/c^2) \quad t=\gamma(t+Vx/c^2)$

$x'=\gamma(x-vt) \quad x=\gamma(x'+vt)$

$$t_2'=(\tfrac{13}{5})(2.0\times10^{-6}s-\frac{(\frac{12}{13})c(75)m}{c^2})$$
$$=(\tfrac{13}{5})(2.0\times10^{-6}s-\tfrac{900}{13}m/c)$$
$$=(\tfrac{13}{5})(1.769\times10^{-6}s)$$
$$t_2'=4.6\times10^{-6}s$$

$$x_2'=(\tfrac{13}{5})(75m-(\tfrac{12}{13})c(2.0\times10^{-6}s))$$
$$=(\tfrac{13}{5})(75m-1.84\times10^{-6}c\cdot s)$$
$$=(\tfrac{13}{5})(75m-554m)$$
$$x_2'=-1245.4m$$

$t_2'=4.6\times10^{-6}s$
$x_2'=-1200\,m$ ✓